Fabrication Procedure Optimizations of Solar Cells

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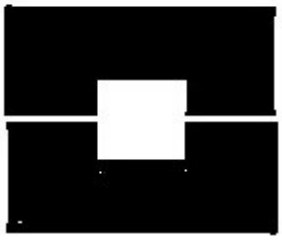
1. Introduction

The main factors affect the efficiency of dye-sensitized solar cell are the thickness of the titanium dioxide nano powder, impurities, dyes and the solar absorption side of the solar cells. First, wash two pieces of FTO glasses with detergent and ethanol. Then wash it by using $TiCl_4$ solution in water bath. Stick the titanium dioxide solution fixing tape (thickness is around 0.1mm) to the conductive side of the FTO glass. Inject the titanium dioxide solution into the spacer of in tape and use blade to make the titanium dioxide solution flat. Heating the FTO glass with titanium dioxide on a hot plate (500 degree C) for 20 min. Wash it by immersing into the $TiCl_4$ water bath again. After cooling down dip this piece of glass into dye solution (N-3, N719) for 24 hours. Spin coat the other piece of FTO glass by adding several drops of H_2PtCl_6 solution (5mM) on the conductive side and heat it on the hot plate at 500 degree C for 20 min as well. Place the 2 pieces

Fig. 1. Shape of Parafilm spacer

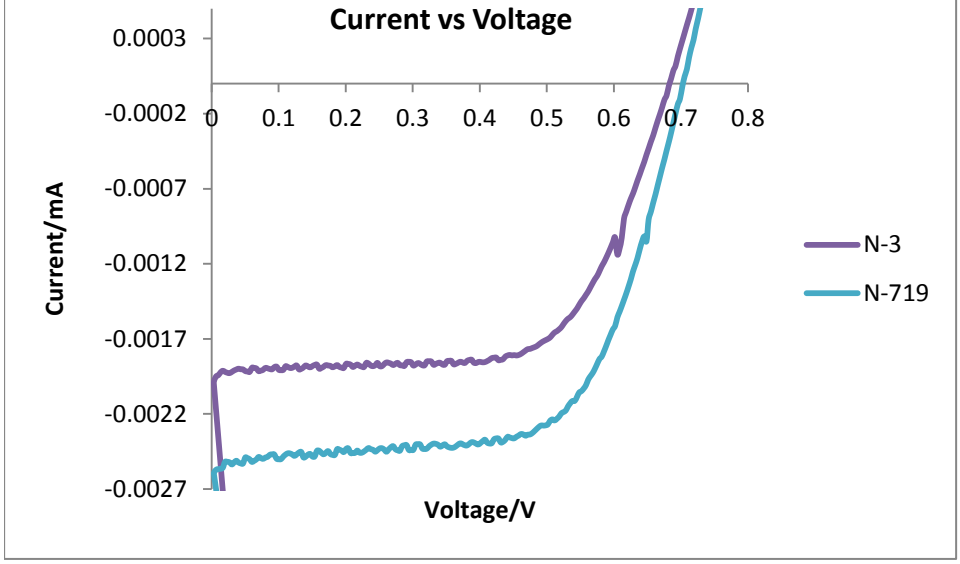


of Parafilm spacer (Fig. 1.) between the two pieces of FTO glass prepared above, and the conductive sides facing to each other. Inject the liquid electrolyte (0.5M lithium iodide and 0.05M iodine in acetonitrile) it to the spacer. At last, use gel to seal the channel.

2. Results

By using different of concentrations of the titanium dioxide to control the thickness, it is obvious that using 0.75 g/mL Titanium dioxide solution is the best for both N-3 and N-719 dyes. Although the efficiency increases with the concentration slightly, fill factor decreases, and the higher concentration lead the titanium dioxide paste easy to break which is not ideal for fabrication. It is also very important that wash glass with $TiCl_4$ solution to remove the impurities like metal ions during farebeating process which enhances about 1% efficiency of solar cells, because the metal ion such as Fe^{3+} is not able to consume the current in titanium dioxide/dye layer. N-719 dye have a higher efficiency (4.60%, fill factor is 64.74%) than N-3 (only 3.41%, fill factor is 64.99%). Using titanium dioxide/dye side to absorb light provides higher efficiencies, because the electrolyte solution attracts a lot of light before it reaches titanium

dioxide/dye layer. As the lamp we use is not a standard solar light source, it provided limited



Graph 1 Currents and voltages generated by solar cells

range of spectrum, so the ideal efficiencies are higher than the results above.

3. Conclusion

The principle and fabrication procedures of dye-sensitized solar cells are similar to quantum dots solar cells. The methods of enhancing and measuring efficiencies are almost the same. The knowledge for solar cells about organic chemistry and photo-electricity is specific and in details which are not taught in undergraduate course or in books. It is very important to select and learn pieces of information from literatures like journals and reviews.

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